

REMARKS

This amendment and these remarks are responsive to the Office action dated February 18, 2003. Claims 18, and 25-44 are pending in the application. Claims 18 and 25-36 are withdrawn from consideration. Claims 37-44 are rejected. New claims 45-52 are added, In view of the amendments above and the following remarks, the applicants respectfully request consideration of the application under 37 C.F.R. § 1.111.

Objections to the Drawings

In the Office action, it is noted that Figures 18 and 19 should be designated by a legend such as --Prior Art--, as only that which is old is illustrated. Applicants have amended Figures 18 and 19 to include such designation, as these figures depict conventional apparatus.

The drawings are objected to as failing to comply with 37 C.F.R. § 1.84(p)(4) because reference character "24" in Figure 1 appears to designate both the conduit for column bottoms liquid and conduit for reboiler output vapor. The applicants have amended Figure 1 to designate the conduit for column bottom liquid return with reference number 23. This amendment is supported in the specification at page 14, lines 6-13.

In view of the amendments to Figures 1, 18, and 19, the applicants request that the objections to the drawings be withdrawn.

Objections to the claims

Claims 39, 41, 42, and 44 are objected to because of informalities. However, applicants have canceled claims 39, 41, 42, and 44 in favor of newly submitted claims 42-52, and suggest that the objections are therefore rendered moot.

Rejections under 35 U.S.C. 112

Claims 37-44 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. Applicants have canceled claims 37-44, and suggest that the rejection of those claims is therefore moot. Applicants further suggest that new claims 45-52 precisely define the claimed invention, and are therefore in compliance with 35 U.S.C. § 112.

Specifically, in new claims 45 and 46, the terms “the first column” and “the second column” are used to express the connection between the columns, rather than the terms “n” and “k”. In addition, the word “type” has been deleted from claims 47 and 50.

Rejections under 35 U.S.C. § 102

Claims 37-38 are rejected under 35 U.S.C. § 102(b) as being anticipated by Atkinson et al. (U.S. Patent No. 4,759,786), claims 37-38 are rejected under 35 U.S.C. § 102(b) as being anticipated by Asselineau et al. (U.S. Patent No. 5,242,550), and claims 37-38 are rejected under 35 U.S.C. § 102(b) as being anticipated by Asselineau et al. (U.S. Patent No. 5,288,370). Claims 37-44 are canceled. The applicants suggest that new claims 45-52 are not anticipated by the cited references.

The apparatus of claim 45 includes introduction conduits which introduce vapor drawn from the reboiler of the first column into the condenser of the second column. The apparatus also includes return conduits that return liquid drawn from the condenser of the second column into the reboiler of the first column. In contrast, in the apparatus shown in Fig. 5 of Atkinson, the introduction conduit connects the bottom of column 8 and the middle portion of column 20. The introduction conduct of Atkinson fails to connect condenser 26 and reboiler 44.

Also with respect to the apparatus of claim 45, the reboiler of the first column and the condenser of the second column are connected with the introduction conduits and the return conduits. In contrast, Asselineau (U.S. Patent No. 5,242,550) shows an apparatus in which the condenser of column C3 is directly connected to column C2 with return conduits 13, 14 and the reboiler of column C2 is directly connected to column C3 with the introduction conduit 10.

Further, in the apparatus of claim 45, the reboiler of the first column and the condenser of the second column are connected with introduction conduits and return conduits. In contrast, Asselineau (U.S. Patent No. 5,288,370) shows the apparatus in which the condenser of column C3 is directly connected to column C2 with return conduit 7, and the reboiler of column C2 is directly connected to column C3 with introduction conduit 13.

In the case of the apparatus of claim 46, the introduction conduit is connected to the top of the second column. In contrast, in the apparatus in Atkinson, the introduction conduit is connected to the middle of column 20.

Also with respect to the apparatus of claim 46, the apparatus includes return conduits that return liquid drawn from the condenser of the second column into the first column. In contrast, in the apparatus in Asselineau, the return conduits 13, 14 return vapor from the condenser into column C2.

Also regarding the apparatus in claim 46, the introduction conduit is connected to the top of the second column. In contrast, in the apparatus of Asselineau, the introduction conduit is connected to the middle of column C3.

In order for a publication to anticipate a claim, each and every element as set forth in the claim must be found in a single prior art reference. For the reasons given above, the applicants suggest that neither the Atkinson reference nor the Asselineau reference anticipates the subject matter of claims 45-52.

Rejections under 35 U.S.C. § 103

Claims 39 and 42 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Atkinson et al. (U.S. Patent No. 4,759,786), as applied to claims 37-38 above, and further in view of Glitsche et al. (U.S. Patent No. 3,969,447) or Chen et al. (U.S. Patent No. 4,604,247); claims 39 and 42 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Asselineau et al. (U.S. Patent No. 5,242,550) as applied to claims 37-38 above, and further in view of Glitsche et al. (U.S. Patent No. 3,969,447) or Chen et al. (U.S. Patent No. 4,604,247); claims 39 and 42 are rejected 35 U.S.C. § 103(a) as being unpatentable over Asselineau et al. (U.S. Patent No. 5,288,370), as applied to claims 37-38 above, and further in view of Glitsche et al. (U.S. Patent No. 3,969,447) or Chen et al. (U.S. Patent No. 4,604,247); claims 37-38, 40-41, and 43-44 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Spevack (U.S. Patent No. 4,788,051) in view of Atkinson et al. (U.S. Patent No. 4,759,786) or Asselineau et al. (U.S. Patent No. 5,242,550) or Asselineau et al. (U.S. Patent No. 5,288,370); and claims 39 and 42 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Spevack (U.S. Patent No. 4,788,051) in view of Atkinson et al. (U.S. Patent No. 4,759,786) or Asselineau et al. (U.S. Patent No. 5,242,550) or Asselineau et al. (U.S. Patent No. 5,288,370), as applied to claims 37-38 above, and further in view of Glitsche et al. (U.S. Patent No. 3,969,447) or Chen et al.

(U.S. Patent No. 4,604,247).

As mentioned above, the apparatus set out in claim 45 includes introduction conduits and return conduits between the reboiler of the first column and the condenser of the second column. Applicants suggest that the resulting apparatus is unobvious over the cited references, for at least the following reasons:

a) Using the claimed apparatus, it is possible to return a part of the condensed liquid to the first column, and it is not necessary to set the pressure in the second column higher than the pressure in the first column. In addition, it is possible to set the pressure within the columns lower than was previously practical, and it is possible to increase the relative vapor pressure between each of the isotopes within each column and thereby improve the efficiency of the distillation process. As a result, it is possible to reduce the packing height of each column, reducing the amount of liquid hold-up, and thereby also shortening the start-up time required.

b) It is possible to take advantage of the pressure of the liquid head in the return conduit to return the liquid from the condenser of the second column to the reboiler of the first column, without requiring the use of a pump to return the liquid.

c) As the claimed apparatus permits the pressure in the second column to be set lower than the pressure in the first column, vapor may be introduced according to the difference in pressure between the first column and second column.

d) As the claimed apparatus permits liquid and vapor to circulate in the introduction/return conduits between the reboiler of the first column and condenser of the second column, the relative concentrations of the contents in the liquid phase and vapor

phase readily reach steady-state values, even if the concentration of the contents in the starting material varies. This results in significantly shorter start-up times for the apparatus.

With respect to the apparatus of claim 46, the reboiler of the first column is connected to the top of the second column via introduction conduits for conducting vapor, and the condenser of the second column is connected to the bottom of the first column via return conduits for conducting liquid. As a result, the bottom of the first column, the reboiler of the first column, the top of the second column, and the condenser of the second column are connected with conduits that include the introduction/return conduits, permitting the liquid and vapor to circulate through the conduits as they are converted between the liquid phase and vapor phase.

Because the introduction conduit is connected to the top of the second column, and the return conduit is connected to the bottom of the first column, the gradient of the concentration of the contents in the liquid and vapor become continuous from the first column to the second column. In other words, the concentration of the contents continuously reduces or increases through the first and second columns. Therefore, the efficiency of the resulting distillation process is improved. It is therefore possible to reduce the packing height of each column, reduce the amount of liquid hold-up, shorten the start-up time before separation can be achieved. In contrast, in the apparatus in Atkinson, the gradient of the concentration of the contents in the liquid and vapor in column 8 and column 20 becomes discontinuous because the introduction conduit is connected to the middle of the column 20.

The concentration of the contents of liquid and vapor become steady-state readily because liquid and vapor circulate the conduits through the bottom of the first column and the top of the second column as they are converted between liquid phase and vapor phase. In contrast, in the apparatus in Asselineau (U.S. Patent No. 5,242,550), only the *vapor* returns to column C2 through return conduits 13, 14. Thus, in the apparatus of Asselineau, the efficiency of the distillation is lower that of the apparatus of claim 46 of the present invention.

In addition, with respect to the apparatus in claim 46, the introduction conduit is connected at the top of the second column, and the return conduit is connected to the bottom of the first column. Thus, the gradient of the concentration of the contents in the liquid and vapor phase becomes continuous from the first column to the second column. As a result, it is possible to reduce the packing height of each column, to reduce the amount of liquid hold-up, and thereby to shorten the start-up time required. In contrast, for the apparatus of Asselineau, the gradient of the concentration of the contents in the liquid and vapor in column C2, C3 becomes discontinuous because the introduction conduits is connected to the middle of the column C3, and the return conduit is connected to the middle of the column C2.

The applicants suggest that there is no suggestion or motivation in the cited references to modify the teaching of the references to arrive at the claimed separation apparatus. Further, that the cited references fail to provide a reasonable expectation of the success of the claimed apparatus. Additionally, that the cited references singly or in combination fail to teach or suggest each and every element of claims 45-52. For these

reasons, the applicants suggest that the cited references fail to establish the *prima facie* obviousness of the claimed apparatus.

In view of the remarks above, the applicants believe that the application is in condition for allowance. Accordingly, applicants respectfully request that the Examiner issue a Notice of Allowability for the pending claims. If the Examiner has any questions, or if a telephone interview would in any way advance prosecution of the application, please contact the undersigned agent of record.

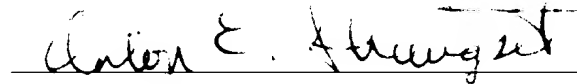
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George Painter

Respectfully submitted,

KOLISCH HARTWELL, P.C.



Anton E. Skaugset

Registration No. 38,617

Customer No. 23581

Agent for Applicants

520 S.W. Yamhill Street, Suite 200

Portland, Oregon 97204

Telephone: (503) 224-6655

Facsimile: (503) 295-6679